

# What Impedes Efficient Product Adoption? Evidence from Randomized Variation in Sales Offers for Improved Cookstoves in Uganda

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*Many people do not purchase products that appear beneficial. For example, the price of an efficient cookstove can be less than a few months' savings on fuel. If liquidity constraints, present bias, and poor information on fuel savings and stove durability are barriers, then a novel sales offer combining a free trial, time payments, and the right to return the stove at any time should increase sales. In a randomized trial, this sales offer increases sales of an efficient charcoal-burning stove in Kampala, Uganda, from 5% to 45%. We provide additional evidence that both liquidity constraints and imperfect information were important barriers.*

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Half the world cooks on inefficient stoves that burn biomass such as wood and charcoal. Smoke from these stoves kills over a million children a year and their inefficient use of fuel contributes to deforestation and global climate change.

Importantly, the high cost of buying or gathering fuel means that inefficient stoves also deepen poverty. Poor people can spend up to a third of their income on cooking fuel (Global Alliance for Clean Cookstoves, 2011: 13). This high expenditure is puzzling because improved cookstoves can reduce fuel costs sufficiently to repay the cost of the stove (*ibid.*). If markets worked well, even poor people would pay for improved cookstoves when the savings on fuel quickly paid for the stove. But in most nations, relatively few households adopt improved cookstoves (*ibid.*).

We hypothesize that demand for improved cookstoves is reduced by liquidity constraints (and possibly present bias), lack of information on the benefits of the improved cookstoves, and lack of confidence that the stove is durable.

If the new cookstove, in fact, saves fuel without too many downsides, a novel cookstove sales offer can address these barriers by combining a free trial period, time payments, and the right to return the stove at any time and stop future payments. In the United States, this combination would be called “rent-to-own” with a free trial period.

This sales offer is well-suited to selling improved stoves, especially for customers who purchase their fuel. Specifically, the first time payment can be set so customers pay it largely or entirely from fuel savings they have already experienced during the free trial. If there is not enough fuel savings, the consumer can just return the stove. This process repeats, so subsequent time payments are also largely recent fuel savings, and if the stove breaks the consumer returns the stove and owes nothing. With this combination of a free trial and “rent-to-own” the customer bears almost no risk the product will not work as advertised (other than the risk of perhaps burning one dinner).

## Theory and Literature Review

### *Theory of Barriers*

When improved stoves can substantially reduce fuel expenditures, slow adoption of improved cookstoves is somewhat mysterious. While poor people have less of most things, in well-functioning markets they should *not* have less of items that make them less poor. Cooking on a traditional stove also creates indoor air pollution that kills over a million children a year. While we do not emphasize health effects, accounting for these benefits deepens the mystery of the slow adoption of improved cookstoves.

We hypothesize that many consumers may not purchase an improved cookstove because of three sets of barriers:

- *Liquidity constraints and present bias*: Consumers find it difficult to come up with the entire purchase price in one lump sum;
- *Savings concerns*: Consumers do not believe the claimed fuel savings from an improved cookstove; and
- *Durability concerns*: Consumers fear the stove will not work or will break quickly.

*Liquidity constraints and present bias.*—There is evidence many consumers in poor nations face liquidity constraints and present bias (Banerjee, 2003; Mullainathan and Shafir, 2009).

Time payments can be an effective means to address liquidity constraints and present bias. Thus, we hypothesize that a sales offer with time payments will increase sales, especially for consumer with liquidity constraints or present bias.

A free trial permits consumers to enjoy a benefit today, but not pay until the trial is over. Thus, we also hypothesize that consumers who show present bias

increase adoption of the stove more when a free trial is added than do consumers without present bias.

*Concerns about fuel savings.*—Consumers are subject to many marketing messages, and they quickly learn that not all salespeople can be trusted.

Customers offered the novel offer or free trial sales offer receive a free trial. A free trial can be a credible signal that the stove, in fact, will save fuel (Moorthy and Srinivasan 1995, Shieh 1996). Davis, *et al.* (1995) emphasize that money-back guarantees increase consumers' willingness to try unfamiliar products when they are unsure of the benefits.<sup>1</sup> In our setting, the free trial period gives women a chance to experience the fuel savings and to determine if the improved cookstove fits the consumers' cooking style and other needs (that is, stoves are “experience goods”). More behaviorally, the trial period may also activate norms of reciprocity, which can increase uptake (Cialdini 2006).<sup>2</sup> All of these forces lead us to hypothesize that a free trial increases uptake, especially among consumers who have low trust in salespeople.

Fuel savings are roughly proportional to baseline fuel use. Thus, we also expect adoption is higher for those with higher baseline fuel use and expenditures and with larger families.

*Concerns about durability.*—Even in rich nations, consumers face the problem that many consumer “durables” are not very durable. Consumers in poor nations face the problem of shoddy merchandise even more often.

Customers offered the novel sales offer or time payments can return the stoves at any time and stop future payments. As with the free trial, the right to return

<sup>1</sup> See also Sanford Grossman (1981), who shows theoretically that a money-back guarantee can reduce adverse selection and increase trade and efficiency.

<sup>2</sup> We thank Adam Galinsky for identifying reciprocity as a possible motive.

reduces risks concerning whether the stove is durable and will deliver the promised savings (Davis, *et al.*, 1995). All of these forces lead us to postulate consumers adopt the stove more often when offered the right to return than when not having that right. In addition, the effect of the right to return on adoption should be strongest for consumers with above-average concerns about durability.

### *Potential Weaknesses of the New Offer*

We were concerned that the stove might break, that it might not cook as consumers prefer, that it might not actually save fuel, or that consumers cannot easily detect the true fuel savings. Any of these forces would lead to high return rates.

The offer will also perform poorly if consumers keep the stove but do not pay for it. Consumers may keep the stove without paying for it because they have moved away or are hard to find at home. In addition, consumers are not required to pay for the stove if the stove is stolen. Less innocently, some consumers may refuse to pay. Incentives to accept a free trial are particularly strong for customers who do not intend to pay, leading to potential adverse selection.<sup>3</sup>

### *Related Sales Offers*

Sellers offer combinations of a free trial period, time payments, and the right to return in many settings.

For example, time payments are at the heart of the microfinance revolution. Energypedia (2011) and MicroEnergy International (2008) discuss linking microfinance with projects that sell improved cookstoves.

<sup>3</sup> We thank Andy Weiss for pointing out this incentive.

Time payments tied to energy savings have been used by some sellers of services to improve the efficiency of heating and air conditioning for buildings in the United States. The logic of these offers is similar to that of the novel offer: buyers of the services do not have an upfront payment, and payments to the seller of services come from fuel savings. The building offers have the added benefit of rewarding incremental improvements in efficiency by the seller of services; they also have the added cost of requiring an estimate of a counterfactual energy bill without the extra services.

Rent-to-own is familiar for selling to poor consumers in the United States (see citations in footnote 2 of Nehf, 1991; Lacko, McKernan and Hastak, 2000). Rent-to-own has also made small inroads in poor nations (e.g., Rent-to-Own Africa, 2011).

## **Methods**

### *Experimental Design*

Our study took place in Kampala, the capitol and largest city in Uganda. Kampala had a population of roughly 1.4 million in 2008 (Uganda Bureau of Statistics, cited in Citypopulation.de, 2008). Uganda is one of the poorest nations in the world, with an infant mortality rate of 65 / 1000 live births, 67% literacy (but only 58% for women), and GPD per capita of \$1200 (2008 estimate, in 2009 US\$ valued at purchasing power parity [CIA, 2010]). The majority of Kampala households cook using a traditional charcoal stove, such as the one pictured in

FIGURE 1.

Our intervention markets the Ugastove improved charcoal stove (FIGURE 2). The Ugastove has strong evidence that it reduces fuel use when tested in controlled settings (Wang, et al., 2009). This evidence was strong enough for the Ugastove to be the first improved stove to pass the voluntary carbon markets “Gold

Standard”, based on kitchen performance tests (Evans 2008). Partly because the price is subsidized by carbon credits, the retail price is \$7.

We worked in Kampala with CIRCODU, an NGO that specializes in market research related to household energy. CIRCODU recruited and trained pairs of stove salespeople on novel offers and on traditional offers for Ugastove improved stoves.

We selected neighborhoods we anticipated had high rates of usage of charcoal stoves (that is, we avoided the very richest neighborhoods where most people cook with gas and the informal settlements where many people cook with wood and waste). Within each neighborhood, sales teams of two enumerators chose homes somewhat at random to make marketing presentations. To reduce peer effects, enumerators chose potential customers who had not seen or heard previous sales presentations. The criteria for household selection were that somebody be home on the day of our sales visit and the household cook with charcoal.

The sales team chose 10 households in each neighborhood to receive the same offer. We kept offers homogeneous within neighborhoods to reduce the social comparison and potential anger if customers heard we had offered a neighbor a better deal. To reduce socioeconomic similarity within a cluster, after 5 households the team returned to the car and drove approximately a kilometer.

At each home the sales team made a marketing presentation about the stove, and the team presented one of the four sales offers: traditional, free trial, time payments, or novel. Sales scripts are in Appendix 1.

Enumerators next recorded the homeowners’ decision. For traditional offers and time payments, they collected the first payment. If consumers asked to defer the decision, salespeople also offered to return one week later for a final decision.

The sales visit ended at this point. Enumerators thanked the consumer for his or her time and offered a small gift (a bar of soap) in exchange for answering a few

more questions. Enumerators then asked consumers a few more questions about liquidity constraints, trust, and concerns and experience with product durability. The survey is in Online Appendix 2.

Over the following months salespeople recorded the experience consumers had with the stoves, including return rates, warranty repair rates, and default rates.

### *Measures of Barriers*

In addition to recording acceptance of free trials, purchases, and payments, we collected a short survey at each household that provided self-reported indicators of our hypothesized barriers.

*Liquidity constraints.*—We classified consumers as liquidity-constrained if they reported they wanted to borrow money in the last 3 months and were either denied a loan that they applied for, or did not ask for a loan out of fear of being refused.

*Present bias.*—To measure present bias we asked two items about simulated intertemporal choices:

- “If a trusted relative wanted to give you a gift, would you choose 6,000 Ushs [about \$3] now or 36,000 Ushs [\$18] in 1 month?”
- “If a trusted relative wanted to give you a gift, would you choose 6,000 Ushs [\$3] in 3 months or 36,000 Ushs [\$18] in 4 months?”

If respondents have time-consistent preferences, they will give the same response to both questions. Others have found frequent preference reversals, with respondents choosing the option of immediate payout, but otherwise being willing to postpone payments if both options are delayed (see Benhabib *et al.*, 2010, and citations therein). We coded consumers as present biased if they chose 36,000 UGX in 4 months over 6,000 UGX in 3 months, but preferred a 6,000 immediate payout over 36,000 in 1 month.

*Concern about fuel savings and product durability.*—We asked one item on trust in the stove’s fuel savings: “Do you believe that this stove will save you half of your current charcoal expenditures?” (coded 1 = Definitely yes to 5 = Definitely no.)

We coded consumers as having “concerns about salesperson honesty” if any of the following are true:

- The consumer replied with "never trust" to the question, "How much would you say you trusted that salesperson/those salespeople?" (conditional on having been visited by door-to-door salesperson in past).
- The consumer replied with 3 or fewer to the question, "Out of 10 salespersons, how many would you say that you would trust?" (conditional on having been visited by door-to-door salesperson in past).
- The consumer replied with "Yes, all" or "Yes, most" to the question, "In your experience, do most salespersons promise more than their products deliver?"

Finally, we classified consumers as having “concerns about product durability” if they report that most or all of the products that they purchase break soon after buying them.

## **Results**

### *Descriptive Statistics and Checks on Randomization*

At baseline median weekly consumption of charcoal was \$2.20, with an interquartile range of \$1.60 to \$3.20. Households (defined as number the respondent regularly cooks for) have a median size of 5 with an interquartile range of 3 to 6.

The several experimental arms are balanced on baseline measures including household size, charcoal expenditures, and prior experience with an improved cookstove (Table 1). In a multinomial logit, these variables are jointly not statistically significant in predicting the experimental arm (results in Online Appendix).

### *Survey Measures of Barriers*

Subjects report low rates of liquidity constraints. Only 4% report that they wanted to borrow money in the last 3 months and were either denied a loan that they applied for, or did not ask for a loan out of fear of being refused.

In contrast, their survey responses indicate very high rates of discounting or present bias, with 63% preferring an immediate payout of \$2.70 payout over \$16 in 6 months (6,000 Ugandan shillings over 36,000 shillings). Almost half these respondents (29% of the entire sample) showed present bias, as they also preferred \$16 in 4 months over \$2.70 in 3 months.

Consumers also showed high concerns about salesperson honesty, with 85% meeting one or more of: “never trusting” door-to-door salespeople, saying that out of 10 salespeople 3 or fewer are trustworthy, and/or replying all or most salespeople promise more than their products deliver.

Many, but fewer, respondents had strong concerns about the durability of products they purchase, with 21% reporting most or all of the products that they purchase break soon after buying them.

### *Effects of Sales Offers and Uptake*

The main results are in Table 2, which shows rates of adoption and payment for each sales offer.

*Traditional Offer.*—Even with the possibility of buying the stove either that day or in a week, only 4% of the households given the traditional sales offer (N = 570 offers) wanted to purchase the stove at the regular price (pooling the posted price and the BDM auction variations of the traditional offer). For those given the traditional offer followed by a BDM auction, the entire demand curve is in Figure 3.

Six percent of the subsample offered a posted price (equal to the retail price) accepted. The share in the auction who bid the retail price or higher was slightly lower, 3% (difference not statistically significant, chi-squared = 2.0, P = 0.15). The somewhat (if not statistically significantly) lower share of bids that equaled the retail price than acceptance of the posted price is consistent with the notion that consumers shaved their bids relative to their actual willingness to pay (Berry, Fisher & Guiteras, 2011). Even if we assume auction bids are 10% below true willingness to pay, the uptake rate at the retail price would have been unchanged.

*Novel offer.*—We were concerned people might not understand or trust the novel sales offer. In fact, 48% percent of households given the novel offer accepted the free trial (166 out of 355 offers).

We were concerned consumers might return the stove because they do not like it, it does not save much fuel, or they could not detect the fuel savings. In fact, only 6% of those who accepted a free trial returned the stove (9 out of 166 who accepted the free trial). A few of these returns were due to consumers lacking money to make a payment, not due to dislike of the stove. (We gave one grace period for consumers who missed a payment.)

Thus, after returns, the novel offer led to sales at 46% of homes (157 sales from 355 offers). To achieve the same uptake with the traditional offer, we would have had to drop prices by roughly 62%. At that lower price, an improved stove would cost barely more than a traditional stove.

The novel offer removes risk from consumers, but opens the seller up to risks of consumer moral hazard; that is, people might steal the stove or merely move away. In fact, we received 97.1% of the expected revenue. That revenue loss was distributed among 7% of those accepting the novel offer who failed to complete all payments. Most of these underpayments occurred when nobody was home during the regular collection visit and one or more follow-ups. We are unsure what share of these households moved away. In a few cases the consumer was home but did not intend to pay. These defaults always occurred after some payments had been made, and 82% of those who paid less than 100% of the price still paid half or more of the price.

In the United States rent-to-own consumers frequently are late with payments (Lacko, McKernan and Hastak, 2000). Late payments might be common in this setting as we charged no late fee to cover higher collection costs. Thus, a concern for the novel offer was the possibility of many additional visits to collect payments. As expected, some novel offer customers required more than 4 collection visits to make all payments, either because they were not home or had no money at the final scheduled collection visit (11% of those who eventually paid in full). To our surprise, a much larger share of customers completed their payments early: fully 35% of those who completed payments.

*Offering only some features of the novel offer.*—We were interested in finding out what barriers the novel offer addressed. If the main problems were difficulty in coming up with the entire purchase price at once and fears about durability, then time payments plus the right to return the stove should raise demand almost as much as the novel offer, even without the free trial. Conversely, if the main problem is that customers doubt the new stove will both lower fuel costs substantially and cook well for them, then a free trial should suffice without time payments.

To test the relative importance of these barriers, we also randomly selected other neighborhoods to receive a sales offer with either the time payments and right to return *or* the free trial, but not both.

Each of these offers raised uptake about half as much as the novel offer. Specifically, a fourth (26%) of the households offered time payments (but without a free trial) and 33% of those offered a free trial (but without time payments) accepted the offer (N = 389 and 539 offers). Return rates were 14% after the free trial (statistically significantly higher at the 1% level than the 5.5% return rates with the novel offer), so only 29% of households offered the free trial ended up accepting the new stove.

Thus, either time payments alone or the free trial alone raised uptake more than 20 percentage points above the 4% uptake with the traditional offer. Moving from either intermediate offer to the novel offer increased uptake by roughly another 20 percentage points, increasing uptake to 46%.

The rates of defaults for the free trials (12%) and for the time payments (7%) were not statistically significantly different from the rate for novel offers (7%). As with the novel offer, defaults for time payments almost always made at least partial payments. As the free trial had only a single scheduled payment, most of its defaults made no payments.

Among those who eventually paid in full, eight percent of households with the time payments required extra collection visits to complete payments, which was similar to the 11% share for the novel offer. Over a third (38%) of those with the time payments completed their payments early; again, this was not statistically distinguishable from the share with the novel offer (35%).

Overall the payment rates on stoves not returned were 97% for the novel offer, 90% for the free trial only, and 96% for time payments only.

### *Household Characteristics of Those Who Adopt the New Stove*

We expect the new stoves to be most valuable for households with higher charcoal expenditures and larger household size. Results are weakly in line with that expectation (Figures 4A and B). For this analysis we compress a handful of outliers reporting spending over \$30 a week for charcoal or reporting more than 40 household members.

On average, adopters used about 20% more charcoal per week than decliners and tended to have about 20% larger households (closer to 6 people than 5). In results not shown, either household size or charcoal expenditure significantly predicts uptake for those offered the traditional offer or time payments, but neither is statistically significant in predicting uptake for the free trial or novel offer. When entered in a regression jointly, household size has a larger effect than charcoal expenditure.

We anticipated that (holding constant sales offer) consumers with present bias, low trust in sales people, and who report most or all of the products that they purchase break soon after buying them will be less likely to adopt the new cookstove when offered the traditional offer. In fact, adopters and decliners of the traditional offer reported almost identical rates of each constraint (see Appendix Table A1).

### *Are Sales Offers Signals of Quality?*

Signaling theories suggest that offering a free trial signals the producer's confidence the product meets consumer needs while guarantees signal durability (Moorthy and Srinivasan 1995; Shieh 1996). Thus, we expect higher confidence in fuel savings for offers with a free trial (relative to the traditional offer) and with the novel offer (that includes a free trial) relative to time payments alone. Similarly, we expect higher confidence in stove durability for offers with time

payments plus the right to return (relative to the traditional offer) and with the novel offer (that includes the right to return the stove) relative to a free trial alone. The prediction about the sales offer signaling durability is muted in this setting because even Ugastove always came with a guarantee to repair flaws due to manufacturing problems (although not due to consumer misuse).

We find no evidence that sales offers affect consumers' confidence in the product. Almost half (46%) of respondents answered "Definitely" to, "Do you believe that this stove will save you half of your current charcoal expenditures?" This fraction was almost identical for all sales offers (Table 5). Similarly, 21% of respondents answered "strongly agree" to, "This stove will probably last 3 years or more." Again, rates of agreement were similar across sales offers (Table 5), with no consistent pattern of greater agreement if the sales offer included the right to return during time payments.

In results not shown, we found the same lack of the predicted relationships when we ran an ordered logit, conditioning on respondents' confidence in salespeople and in product durability more generally. These results do not support the hypotheses that a free trial can signal fuel savings and the right to return can signal durability.

#### *Importance of Sales Offer Terms to Subgroups Reporting Related Concerns*

We hypothesized a sales offer with terms that addressed a specific constraint would increase uptake the most among households who reported that constraint. For example, time payments would matter more to customers who report liquidity constraints than to others. Because the novel offer differs from the free trial by the addition of time payments, it should also increase sales relative to the free trial disproportionately among those reporting liquidity constraints.

In addition, those with low trust in salespeople should increase demand the most when offered the free trial (compared with those given the traditional offer) or the novel offer (compared with those offered just time payments).

Finally, the right to return (which was included with time payments) should matter most for those reporting concerns about product durability; similarly, the novel offer should increase sales relative to the free trial for those with durability concerns.

Of the six tests only 2 are of the right sign and none are statistically significant (Web Appendix Table A2). Overall these hypotheses do not receive support.

## **Conclusion**

### *Summary*

Our main result is that a sales offer with either time payments or with a free trial increases uptake of improved cookstoves from 5% to 25%. Combining them into the novel sales offer (which also includes the right to return the stove and stop payments) increases uptake further to 45%. Return rates and default rates were both quite low in this sample.

The novel sales offer was designed to address liquidity constraints, present bias, concerns about savings and concerns about durability. Thus, the success of the novel offer suggests these barriers are collectively important.

Further supporting the role of these barriers, in our survey consumers reported high or very high rates of liquidity constraints, present bias, concerns about savings, and concerns about durability.

At the same time, those reporting these constraints did not purchase improved stoves less often. In addition, there is no evidence that the terms of the sales offer that address a barrier (such as a free trial for those with concerns about

salespersons' honesty) increased adoption more for those reporting the barrier than for others.

It is likely that some respondents under-report near-pervasive constraints; for example, that few respondents trust salespeople's promises and almost all consumers fear that a new stove will not last long. If there is substantial under-reporting of near-pervasive constraints we do not expect to see an interaction. The modest number of adopters given the traditional offer also limits precision of some of these tests.

There is also no support for the hypotheses that a free trial signals fuel savings or that the right to return signals durability. While these results provide no support for signaling theories, they could also be due to weaknesses in our self-reported measures of belief in the stove's fuel savings and durability.

### *Discussion*

The barriers we identified – liquidity constraints, concerns about savings, and concerns about durability – appear important for many consumers. In addition, the improved sales offer we tested appears to address these barriers. At the same time, we were not able to identify how the different components of the novel sales offer overcame specific barriers.

We also identified important anomalies to a simple understanding of the barriers. For example, although our sample showed very high self-reported discount rates, there were also high rates of pre-payment. Separately from the survey results, we have some qualitative evidence that is consistent with the common view that for many Ugandans debt is undesirable. Several respondents, for example, said they were pre-paying so the stove salesperson would not come by for collections; they apparently feared the stigma attached with owing time payments. Pre-payment may also have been motivated by the irregular nature of

many customers' incomes coupled with the challenges of saving; by prepaying when they had cash on hand, they reduced the risk of losing the stove if they had no cash when the next payment was due.

### *Limitations and Implications*

*For researchers.*— Failing to purchase a cost-effective cookstove is a natural laboratory for studying human decision-making. Our overall results suggest the combination of barriers we identify is important, but our research methods were not able to distinguish their relative importance.

Some of the concerns were due to our measures. We used short scales, which limits reliability. We relied on self-reports, when behavioral measures typically have higher validity. Data collection was by the salespeople, which can increase politeness bias (particularly when reporting if salespeople are trustworthy). Future research (with a larger budget) can address each of these limitations: using real-money games to measure discounting and liquidity constraints, and so forth.

More generally, future research can offer a wider variety of sales offers. By measuring willingness to pay when offered different timing and number of payments it should be feasible to disentangle liquidity constraints, present bias, and high subjective discount rates.

*For practitioners.*— The novel sales offer has been highly effective at increasing uptake of an improved Ugastove. We hope to test whether a business model can implement the novel offer at much lower transaction costs using either mobile banking or existing groups.

Local salespeople usually have limited liquidity to lend stoves to customers and limited ability to bear the risk of customer returns and defaults. We are interested in testing novel distribution contracts that can induce salespeople to make the

novel sales to customers while still giving salespeople incentives to select reliable customers, to work hard to collect payments, and to truthfully report payments.

It is important to understand what products work well with the novel offer. For example, we are currently (as of 2012) testing the sales offer with wood-burning stoves. Wood and other biomass fuels are typically gathered, unlike the purchased charcoal used in our trials so far. We would like to explore under what circumstances the (often male) financial decision-makers will pay to save the time of those (typically women and children) who gather fuel.

It is also important to test if a sales offer combining a free trial plus a “subscription” for fuel can work with stoves that use distinctive fuels such as LPG or briquettes. More generally, it would be valuable to test how well the novel sales offer increases adoption of goods that avert costs, such as a water filter that reduces the need to purchase fuel for boiling water. Eventually we hope to test the novel sales offer for goods that raise a small business’s revenue, such as solar-powered lights for merchants at night markets.

The goal of most programs for improved cookstoves is to reduce fuel use (to reduce deforestation and global climate change) and to reduce household air pollution. Thus, it is important both to increase use of efficient and low-emissions stoves and also to reduce use of old stoves – a goal more ambitious than our sales offer can achieve. It is important to study how to combine sales of new stoves with behavior change programs (using information, incentives, shifts in norms, etc.).

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FIGURE 1: TRADITIONAL CHARCOAL STOVE



FIGURE 2: UGASTOVE IMPROVED STOVE

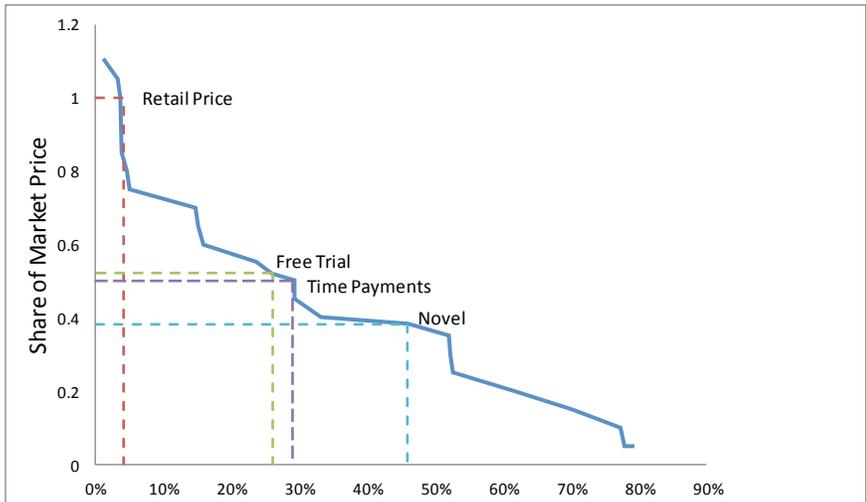


FIGURE 3: DEMAND CURVE FROM INCENTIVE-COMPATIBLE AUCTION WITH TRADITIONAL OFFER

*Notes:* The vertical lines indicate uptake for the 4 sales offers: 3% for traditional offer (using the BDM auction), 26% for the free trial, 29% for time payments, and 46% for the novel sales offer. For the free trial, time payments and novel offer the uptake calculations are not from the auction, but from separate sales that were not followed by returns. The horizontal lines indicate the price (relative to the market price) required for the traditional offer to achieve the uptake of the other sales offers. Specifically, it took a reduction of roughly half to have as many bidders accept the BDM auction with the traditional offer as accepted the free trial or time payments, and a reduction of 62% off regular price to have the same uptake as the novel offer.

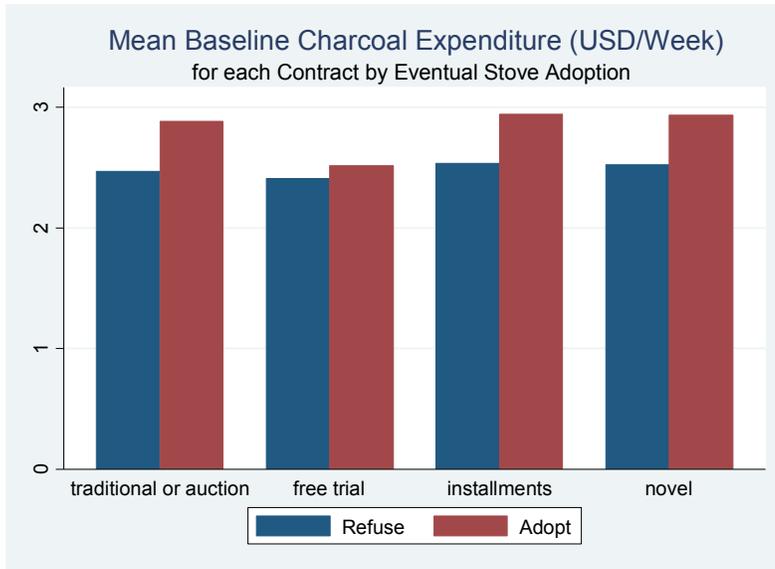


FIGURE 4A: MEAN BASELINE CHARCOAL EXPENDITURE

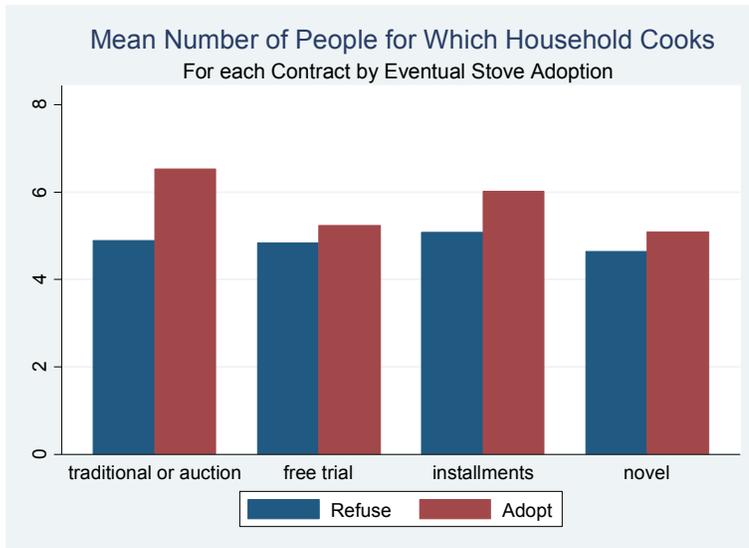


FIGURE 4B: MEAN NUMBER OF PEOPLE IN HOUSEHOLD

TABLE 1—BASELINE HOUSEHOLD CHARACTERISTICS AND RANDOMIZATION CHECKS

	By Contract				Overall	Test of Row Equality (chi2)
	Traditional and Auction	Free Trial	Time Payments	Novel		
<b>Baseline Charcoal Expenditure (USD per week)</b>						
Mean	2.5	2.5	2.7	2.7	2.6	0.23
Standard Deviation	1.5	1.6	1.7	1.5	1.6	
10th Percentile	1.1	1.1	1.1	1.6	1.1	
50th Percentile	2.1	1.6	2.8	2.7	2.1	
90th Percentile	3.7	3.7	4.5	3.8	3.7	
<b>Household Size</b>						
Mean	4.9	4.9	5.4	4.8	5.0	0.17
Standard Deviation	2.6	2.5	2.8	2.7	2.7	
10th Percentile	2	2	2	2	2	
50th Percentile	4	5	5	4	4	
90th Percentile	8	8	9	8	8	
<b>Prior Experience with Stoves</b>						
% who use more than one stove on weekly basis	70.9	64.5	68.3	71.1	68.5	0.33
%who use non-improved charcoal-burning clay stove on weekly basis	88.8	84.6	85.9	82.5	85.8	0.13
%who use non-improved charcoal-burning metal stove on weekly basis	33.4	34.5	34.8	36.6	34.6	0.88
%who already own improved charcoal stove (ICS)	6.7	9.0	9.5	7.7	8.2	0.36
%of non-owners who have seen an ICS before	51.3	57.0	50.7	49.7	52.5	0.50
% aware that ICSs save fuel, of those who have seen an ICS before	54.8	48.3	55.8	54.8	53.0	0.55
Number of Observations	534	483	357	316	1690	

*Notes:* We dropped 13 household reporting \$45 or more per week in charcoal expenditures; all other responses were below \$20 / week. We dropped two households reporting 500 members; all other respondents reported 20 or fewer members. The exact number of responses for a given question may be slightly lower due to missing values.

TABLE 2: ADOPTION AND PAYMENTS SUMMARY, BY SALES OFFER

	Traditional/ Auction	Free Trial	Time Payments	Novel	Test of Row Equality (chi2)
# of offers to randomized homes	Fixed price: 114 Auction: 456	539	389	355	
Share of offers accepted	Fixed price: 6% Auction: 3% <sup>a</sup>	33%	26%	48%	.00
Among accepted offers					
% returned		14%	1%	6%	.10
% paid in full		73%	92%	87%	
% finished paying early, of those who fully paid		9%	38%	35%	
% finished paying late, of those who fully paid		8%	12%	11%	
% Stoves in default		12%	7%	7%	.24
% of stoves in default that paid > 0		42%	83%	100%	
% of stoves in default that paid ≥ half of price		33%	50%	82%	
Eventual uptake (after returns) as share of offers	4% (combined)	29%	26%	46%	.00
Share of money received (relative to retail price of stoves that were not returned)	100%	89.9%	96.1%	97.1%	

*Note:* The Test of Row Equality column reports the p-value of the chi-squared statistic of a multinomial logistic regression predicting sales.

<sup>a</sup> This is the percent of households that bid the stove's retail price or higher. The fact that the share bidding the retail price is lower than the percent of households that accepted the fixed-price traditional offer of the retail price is consistent with some consumers shaving their bids slightly below their actual willingness to pay, although the difference in shares is not statistically significant. Adding 10% to all bids does not increase uptake in the auction.

TABLE 3: ARE SALES OFFERS GOOD SIGNALS OF QUALITY?

	Sales Offer				Overall
	Traditional & auction	Free Trial	Time Payments	Novel	
Reply “Definitely yes” to “Do you believe that this stove will save you half of your current charcoal expenditures?”	48%	<b>44%</b>	40%	<b>51%<sup>a</sup></b>	46%
Reply “Strongly agree” to “This stove will probably last 3 years or more?”	22%	21%	<b>20%</b>	<b>22%</b>	21%
N	513	433	299	214	1,459

*Note:* Signaling theory suggests the shaded cells will be larger than the cells immediately to their left on the top row and two columns to their left on the bottom row.

<sup>a</sup> for  $P < 0.05$  for this comparison one column at a time. Neither joint test of both comparisons in a row is statistically significant at the 10% level.

## For online publication

TABLE A1: HOUSEHOLD CHARACTERISTICS OF THOSE WHO ACCEPT AND DECLINE EACH SALES OFFER

		Liquidity-Constrained or Present-Biased	Concerns about Salesperson Honesty	Concerns about Product Durability	Minimum Sample Size
Traditional offer or Auction	Accept	0.30	0.86	0.35	19
	Decline	0.35	0.84	0.21	420
Free Trial	Accept	0.35	0.87	0.19	115
	Decline	0.34	0.92	0.27	269
Installments	Accept	0.43	0.86	0.22	79
	Decline	0.38	0.81	0.14	190
Novel offer	Accept	0.44*	0.82	0.16**	107
	Decline	0.31*	0.78	0.29**	84
Overall	Accept	0.39	0.85	0.20	320
	Decline	0.35	0.85	0.22	963

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$  for null hypothesis that acceptors and decliners do not differ (Fisher's exact test for proportions.) Sample sizes differ slightly across columns due to missing values. Listed are the minimum sample sizes for each row.

### Definitions of Consumer Traits:

**Liquidity-constrained** consumers are those who report that they wanted to borrow money in the last 3 months and were either denied a loan that they applied for, or did not ask for a loan out of fear of being refused.

**Present-biased** consumers are those who preferred 36,000 UGX in 4 months over 6,000 UGX in 3 months, but preferred a 6,000 immediate payout over 36,000 in 6 months.

Consumers have "**concerns about salesperson honesty**" if any of the following are true:

- replied with "never trust" to the question, "How much would you say you trusted that/those salespeople?" (Conditional on having been visited by door-to-door salesperson in past.)
- replied with 3 or fewer to the question, "Out of 10 salespersons, how many would you say that you would trust?" (Conditional on having been visited by door-to-door salesperson in past.)
- replied with "yes, all" or "yes, most" to the question, "In your experience, do most salespersons promise more than their products deliver?"

Consumers have "**concerns about product durability**" if they report that most or all of the products that they purchase break soon after buying

TABLE A2: DO CONTRACTS THAT ADDRESS CONSUMER CONSTRAINTS MATTER MOST?

Outcome = adopt new stove. Each column is a different model, focusing on one set of consumer constraints.

	Liquidity/ Present-Bias	Low Trust in Salespeople	Durability Concerns
Time Payments Only	7.657*** (2.882)	7.800*** (5.175)	10.32*** (3.846)
Free Trial Only	8.323*** (2.962)	17.68*** (10.64)	14.18*** (4.972)
Novel Contract	20.32*** (7.533)	26.00*** (15.74)	39.81*** (14.63)
Liquidity/Present-Bias*Traditional	0.813 (0.441)		
Liquidity/Present-Bias*Installments	1.211 (0.329)		
Liquidity/Present-Bias*Free-trial	1.026 (0.244)		
Liquidity/Present-Bias*Novel	1.747 (0.626)		
Low Trust in Sales People*Traditional		1.133 (0.643)	
Low Trust in Sales People*Free-trial		0.610 (0.195)	
Low Trust in Sales People*Installments		1.395 (0.552)	
Low Trust in Sales People*Novel		1.237 (0.324)	
Durability Concerns*Traditional			1.992 (1.047)
Durability Concerns*Installments			1.664* (0.443)
Durability Concerns*Free-trial			0.663 (0.214)
Durability Concerns*Novel			0.447** (0.169)
Fraction of population with Trait	0.360	0.850	0.215
Observations	1285	1444	1413

Values are the exponentiated coefficients from a logistic regression. Standard errors are in parentheses. \* and \*\* for statistically significantly different from zero at the 5% and 1% levels. See definitions of consumer traits in notes to Table A1.

Our hypotheses predict the upper coefficient within each box to be less than the lower coefficient. In fact, none of the contrasts within a box is significant at the 5% level.

Online Appendix 2: Survey

8a	<b>Do you believe that this stove will save you half of your current charcoal expenditures?</b>	<ol style="list-style-type: none"> <li>1. Definitely yes</li> <li>2. Maybe yes</li> <li>3. Unsure</li> <li>4. Maybe no</li> <li>5. Definitely no</li> <li>6. No reply</li> <li>7. Did not understand question</li> </ol>
8b	<b>Do you agree or disagree that that this stove will probably last 3 years or more?</b>	<ol style="list-style-type: none"> <li>1. Strongly agree</li> <li>2. Agree</li> <li>3. Neither agree nor disagree</li> <li>4. Disagree</li> <li>5. Strongly disagree</li> <li>6. No reply</li> <li>7. Did not understand question</li> </ol>
9	<b>What share of products you buy break soon after you purchase them?</b>	<ol style="list-style-type: none"> <li>1. All</li> <li>2. Most</li> <li>3. Few</li> <li>4. None</li> <li>5. Not sure</li> <li>6. No reply</li> <li>7. Did not understand question</li> </ol>
10a	<b>Have other salesperson(s) in the past visited your home selling a product door-to-door?</b>	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. No [<i>Skip to 11</i>]</li> <li>3. Not sure [<i>Skip to 11</i>]</li> <li>4. No reply [<i>Skip to 11</i>]</li> </ol>
10b	<i>[If yes]</i> <b>How much would you say you trusted that/those salesperson(s)?</b>	<ol style="list-style-type: none"> <li>1. Completely trust</li> <li>2. Somewhat trust</li> <li>3. Never trust</li> <li>4. Not sure</li> <li>5. No reply</li> <li>6. Did not understand question</li> </ol>
10c	<i>[If yes]</i> <b>Out of 10 salespersons, how many would you say that you would trust?</b>	<i>Answer must range between 0-10</i>  _____
11	<b>In your experience, do most salespersons promise more than their products deliver?</b>	<ol style="list-style-type: none"> <li>1. Yes, all overpromise</li> <li>2. Yes, most overpromise</li> <li>3. No, few overpromise</li> <li>4. No, none overpromise</li> <li>5. Not sure</li> <li>6. No reply</li> <li>7. Did not understand question</li> </ol>
12	<b>Generally speaking, would you say that most people can be trusted, OR that you need to be very careful when dealing with people?</b>	<ol style="list-style-type: none"> <li>1. Most people can be trusted</li> <li>2. You need to be very careful when dealing with people</li> <li>3. Not sure</li> <li>4. No reply</li> <li>5. Did not understand question</li> </ol>

13	<p><b>Which one of the following statements reflects best your view?</b></p> <p><b>I will not trust a person until there is clear evidence that he or she can be trusted.</b></p> <p><b>OR</b></p> <p><b>I will trust a person until I have clear evidence that he or she can't be trusted.</b></p>	<ol style="list-style-type: none"> <li>1. I will not trust a person until there is clear evidence that he or she can be trusted.</li> <li>2. I will trust a person until I have clear evidence that he or she can't be trusted.</li> <li>3. Not sure</li> <li>4. No reply</li> <li>5. Did not understand question</li> </ol>
14a	<p><b>If a trusted relative wanted to give you a gift, would you choose <u>6,000/= now</u> or <u>36,000/= in 1 month</u>?</b></p>	<ol style="list-style-type: none"> <li>1. 6,000/= now</li> <li>2. 36,000/= in 1 month</li> <li>3. Not sure</li> <li>4. No reply</li> <li>5. Did not understand question</li> </ol>
14b	<p><b>If a trusted relative wanted to give you a gift, would you choose <u>6,000/= in 3 months</u> or <u>36,000/= in 4 months</u>?</b></p>	<ol style="list-style-type: none"> <li>1. 6,000/= in 3 months</li> <li>2. 36,000/= in 4 months</li> <li>3. Not sure</li> <li>4. No reply</li> <li>5. Did not understand question</li> </ol>
15a	<p><b>In the last 3 months, have you wanted to borrow money?</b></p>	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. No [<i>Skip to 16a</i>]</li> <li>3. Unsure [<i>Skip to 16a</i>]</li> <li>4. No reply [<i>Skip to 16a</i>]</li> <li>5. Did not understand question [<i>Skip to 16a</i>]</li> </ol>
15b	<p><i>[If yes to 15a]</i></p> <p><b>In the last 3 months, did you try to get a loan?</b></p>	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. No [<i>Skip to 15d</i>]</li> <li>3. Unsure [<i>Skip to 15d</i>]</li> <li>4. No reply [<i>Skip to 16a</i>]</li> <li>5. Did not understand question [<i>Skip to 16a</i>]</li> </ol>
15c	<p><i>[If yes to 15b]</i></p> <p><b>Did you get the loan?</b></p>	<ol style="list-style-type: none"> <li>1. Yes [<i>Skip to 16a</i>]</li> <li>2. No [<i>Skip to 16a</i>]</li> <li>3. Not sure [<i>Skip to 16a</i>]</li> <li>4. No reply [<i>Skip to 16a</i>]</li> <li>5. Did not understand question [<i>Skip to 16a</i>]</li> </ol>
15d	<p><i>[If no to 15b]</i></p> <p><b>In the last 3 months, have you decided not to ask for a loan for fear you would get refused?</b></p>	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. No</li> <li>3. Not sure</li> <li>4. No reply</li> <li>5. Did not understand question</li> </ol>
16a	<p><b>Do you have any loans on which you pay interest?</b></p>	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. No [<i>Skip to 16c</i>]</li> <li>3. Not sure [<i>Skip to 17a or 19a</i>]</li> <li>4. No reply [<i>Skip to 17a or 19a</i>]</li> <li>5. Did not understand question [<i>Skip to 17a or 19a</i>]</li> </ol>
16b	<p><i>[If yes]</i></p> <p><b>What is the highest monthly interest rate you pay on a loan?</b></p>	<p>_____ %</p>
16c	<p><i>[If no]</i></p> <p><b>If you wanted to borrow 10,000/=, would you expect to pay more, less, or exactly 5% (500/=) of interest each month?</b></p>	<ol style="list-style-type: none"> <li>1. Expects to pay less than 5% (500/=)</li> <li>2. Expects to pay exactly 5% (500/=)</li> <li>3. Expects to pay more than 5% (500/=)</li> <li>4. Not sure</li> <li>5. No reply</li> <li>6. Did not understand question</li> </ol>

17a	<b>If you could have paid 4 weekly payments of [3,500 / 4,500 / 5,500], would you have wanted to purchase the new stove?</b>	1. Definitely yes 2. Maybe yes 3. Unsure [Skip to 17e] 4. Maybe no [Skip to 17e] 5. Definitely no [Skip to 17e] 6. No reply [Skip to 17e] 7. Did not understand question [Skip to 17e]	
17b	<i>[If yes]</i> <b>Would you have wanted to pay the first payment today or in 1 week?</b>	1. First payment today 2. First payment in 1 week 3. Not sure 4. No reply 5. Did not understand question	
17e	<b>If you had accepted the stove, do you think WE would allow you to return the stove in a week.....(Ask ALL options)</b> Circle corresponding number for each option: 5 if <u>definitely sure</u> they can return the stove 4 if think they <u>probably</u> can return the stove 3 if <u>unsure</u> whether or not they can return the stove 2 if think they <u>probably cannot</u> return the stove 1 if think they <u>definitely cannot</u> return the stove 0 if <u>did not respond</u>	5 4 3 2 1 0	...if stove breaks?
		5 4 3 2 1 0	...if do not like stove?
		5 4 3 2 1 0	...if <i>no</i> fuel savings?
		5 4 3 2 1 0	...if <i>not enough</i> fuel savings?
		5 4 3 2 1 0	...if have no money to pay installment?
		5 4 3 2 1 0	...if finds a better stove?
17f	<b>If you had accepted the stove and we let you return the stove under all conditions, would YOU decide to return the stove in a week.....(Ask ALL options)</b> Circle corresponding number for each option: 5 if <u>definitely sure</u> they can return the stove 4 if think they <u>probably</u> can return the stove 3 if <u>unsure</u> whether or not they can return the stove 2 if think they <u>probably cannot</u> return the stove 1 if think they <u>definitely cannot</u> return the stove 0 if <u>did not respond</u>	5 4 3 2 1 0	...if stove breaks?
		5 4 3 2 1 0	...if do not like stove?
		5 4 3 2 1 0	...if <i>no</i> fuel savings?
		5 4 3 2 1 0	...if <i>not enough</i> fuel savings?
		5 4 3 2 1 0	...if have no money to pay installment?
		5 4 3 2 1 0	...if finds a better stove?

18	<b>If I had been able to offer you a week-long free trial, would you have accepted the free trial?</b> <i>With a free trial, I would have returned in a week and either asked for the stove back or the payment of [14,000 / 18,000 / 22,000] /=-.</i>	1. Definitely yes 2. Maybe yes 3. Unsure 4. Maybe no 5. Definitely no 6. No reply 7. Did not understand question	
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(The following 2 questions appear on later versions of the “installments” and “novel” contract survey forms. Note: some versions of forms contained only options 0 – 4.)

19c	<b>Do you think WE will allow you to return the stove in a week.....(Ask ALL options)</b>	5 4 3 2 1 0	...if stove breaks?
	Circle corresponding number for each option:	5 4 3 2 1 0	...if do not like stove?

	5 if <u>definitely sure</u> they can return the stove 4 if think they <u>probably</u> can return the stove 3 if <u>unsure</u> whether or not they can return the stove 2 if think they <u>probably cannot</u> return the stove 1 if think they <u>definitely cannot</u> return the stove 0 if <u>did not respond</u>	5 4 3 2 1 0	...if <i>no</i> fuel savings?
		5 4 3 2 1 0	...if <i>not enough</i> fuel savings?
		5 4 3 2 1 0	...if have no money to pay installment?
		5 4 3 2 1 0	...if finds a better stove?

19d	<b>Assuming we let you return the stove under all conditions, will YOU decide to return the stove in a week.....(Ask ALL options)</b>  Circle corresponding number for each option:  5 if <u>definitely sure</u> they can return the stove 4 if think they <u>probably</u> can return the stove 3 if <u>unsure</u> whether or not they can return the stove 2 if think they <u>probably cannot</u> return the stove 1 if think they <u>definitely cannot</u> return the stove 0 if <u>did not respond</u>	5 4 3 2 1 0	...if stove breaks?
		5 4 3 2 1 0	...if do not like stove?
		5 4 3 2 1 0	...if <i>no</i> fuel savings?
		5 4 3 2 1 0	...if <i>not enough</i> fuel savings?
		5 4 3 2 1 0	...if have no money to pay installment?
		5 4 3 2 1 0	...if finds a better stove?

(The following question appears on the "installments" contract survey form)

20	<b>The offer today had two unusual features:</b> - Time payments - The right to return the stove and stop future time payments  <b>Which of these features were important in your decision to accept the stove and which were unimportant?</b>	MOST      LEAST
		Time Payments _____ Right to Return _____

(The following question appears on the "novel" contract survey form)

20	<b>The offer today had three unusual features:</b> - A free trial - Time payments - The right to return the stove and stop future time payments  <b>Which of these features were important in your decision to accept the stove and which were unimportant?</b>	MOST      LEAST
		Free Trial _____ Time Payments _____ Right to Return _____